



ASSOCIATION OF RESEARCHERS IN **CONSTRUCTION MANAGEMENT**

TWENTY-EIGHTH
ANNUAL
CONFERENCE
2012
September 3-5

Edinburgh

Volume 2

Association of Researchers in Construction Management (ARCOM)

Proceedings of the 26th Annual Conference

Edited by Simon Smith

First published 2012

ISBN: 978-0-9552390-6-9 (2 Vols.)

Published by

ARCOM, Association of Researchers in Construction Management
c/o School of Construction Management and Engineering
University of Reading
PO Box 219
Reading
RG6 6AW, UK

© Association of Researchers in Construction Management

All rights reserved. No part of this publication may be reproduced in any material form (including photocopying or storing in any medium by electronic means whether or not transient or incidentally to some other use of this publication) without the permission of the copyright holder except in accordance with the provisions of the Copyright Designs and Patents Act 1988. Authors of papers in these proceedings are authorised to use their own material freely. Applications for the copyright holder's written permission to reproduce any part of this publication should be addressed to:

Dr Simon Smith
School of Engineering
Alexander Graham Bell Building
Edinburgh, EH9 3JL
simon.smith@ed.ac.uk

ARCOM Declaration:

The papers in these proceedings were **double refereed** by members of the scientific committee in a process that involved detailed reading of the papers, reporting of comments to authors, modifications of papers by authors and re-evaluation of re-submitted papers to ensure quality of content.

FOREWORD

Welcome to Edinburgh for the 28th edition of the Association of Researchers in Construction Management's annual conference. This year's conference promises to be one of the biggest yet, and returns to Scotland's capital for the second time, having first been hosted by Heriot-Watt University in 2004; and to Scotland for the third time after Glasgow in 2000.

This year's conference call attracted a huge amount of interest. 329 abstracts were submitted in February, which resulted in 181 full papers. This has been further reduced to 134 final accepted papers, all of which appear in full in these proceedings. This is one of the highest number of papers that an ARCOM conference has seen and is testament to the popularity, quality and importance of this annual showcase of the best research in international construction management research, particularly at a time of financial difficulty for so many delegates. It is possibly also a reflection of the popularity of our host city for 2012. The Scottish capital needs little to persuade us to visit its mix of Georgian and Medieval streets and our location for the conference itself, at the foot of the Salisbury Crags and Arthur's Seat; opposite the Holyrood Parliament and next to the Queen's Park and Holyrood Palace will hopefully inspire enlightened debate!

In recent years ARCOM, and the ARCOM conference, have grown to become an internationally significant institution. The committee has recognised this yet has steadfastly refused to attempt to cash in on this popularity; rather we have tried to increase the quality of the papers presented. Thus we maintain quite strict standards of academic quality and rigour in our review process. This is impossible without the efforts of its Scientific Committee and I must pause to hopefully ensure all delegates are aware of the key role that these 67 people have played in the development and passage of their papers through the review process. It is worth pointing out that a total of 1333 separate reviews were conducted in order that the proceedings appear as they do.

The industry we research is, as ever, facing a great deal of challenges. It has been very hard hit in Europe by the worldwide financial situation with negative growth in the last year in some countries. It is not just construction that has been hit of course, and this downturn is seen in the academic and higher education sectors also. Frustratingly, many academics are unable to fund and thus fully develop the knowledge and understanding in the way they wish to in order to prepare for better times to come. Yet we continue to see progression and changes in the make up of the research presented at our conference. In particular we continue to see a development of understanding of people: the way they behave, the differences in cultures, how they might be treated and protected better and how the diversity of a workforce can be recognised and treated correctly. This must give us hope for the future, that when the world is able to develop its infrastructure and countries that have lain idle for so long can be allowed to grow that its workforce will be better able to deliver. The papers in these proceedings on equality and diversity; on respect for people; on behavioural and cultural differences are a reflection of this and one only needs to look at the table of contents of proceedings from the early '00s to see how trends have changed. These themes have become more prominent.

In recent years the sustainability agenda has rightly affected the way we approach our work and has resulted in a huge increase in research on sustainability theory, low carbon construction, environmental assessment and of energy reduction. The number of papers on sustainability in this year's proceedings is the largest by some margin in comparison to the other themes. 23 papers have been separated out in to two themes: sustainability theory and design issues as well as research on the operation and practice of sustainability implementation. Many works reflect the policy and strategic governmental changes to produce low carbon dwellings and public buildings.

This year we see a new theme on Building Information Modelling and while the large number of abstracts submitted in this area did not, unfortunately, translate to a similar number of accepted final papers, it is clear that there is much work to be done to appreciate the benefits – and uses – of this new technology; and to educate the breadth of the industry on how to exploit and utilise it. I suspect this will be a growing theme for the next few years.

Papers come from a wide variety of sources. This year, over twenty countries are represented with a vast number of papers coming out of PhD and postgraduate research. ARCOM is proud to nurture this talent and it is also very gratifying to see that a large number of experienced academics number among the registered delegates. I am hoping that the long ARCOM tradition of support and encouragement of early career researchers continues in the debate and discussion, in both lecture room and social arenas of this conference.

There are eight paper prizes to be awarded this year. Three are ARCOM's own awards, commemorating past chairs and committee members Rod Howes, Paul Townsend and David Langford. Five awards are funded by our sponsors: CIOB, RICS and publishers Wiley-Blackwell and Taylor & Francis. The late Prof. Dave Langford is also remembered by the Second Annual Langford Lecture, this year delivered by Aletha Holborough from University of Westminster.

It goes without saying that a conference of this nature needs a lot of support and work behind the scenes and a note of thanks must as always go to the main ARCOM committee in addition to the scientific committee mentioned above. Particularly thanks to Paul Chan, Ani Raiden and Stephen Gruneberg for managing our debate and keynote speaker sessions. I'd like to offer thanks and appreciation to Will Hughes for his support and advice on academic, editorial and many other issues. And last but not least a sincere nod to our new Conference Secretary, Dominic Ahiaga-Dagbui whom most of you will already know from his numerous email communications.

Go forward and enjoy. Engage in debate, make new friends, renew old acquaintances, advance and further our field and have a good time doing so!

Dr Simon D Smith, University of Edinburgh, UK
ARCOM 2012 Conference Editor

ARCOM COMMITTEE 2011-2012

Professor Charles Egbu, University of Salford, UK (Chair)

Dr Simon Smith, University of Edinburgh, UK (Vice-Chair and Conference Editor)

Professor Andrew Dainty, Loughborough University, UK (Immediate Past Chair)

Dr Paul Chan, University of Manchester, UK (Secretary)

Dr Shu-Ling Lu, University of Reading, UK (Membership Secretary)

Dr Stephen Gruneberg, University of Westminster, UK (International Officer)

Professor Will Hughes, University of Reading, UK (CM Abstracts and Webmaster)

Dr Robby Soetanto, Loughborough University, UK (Publications Officer)

Professor Paul Stephenson, Sheffield Hallam University, UK (Workshops Convenor)

Dr Christopher Gorse, Leeds Metropolitan University, UK (CIOB Liaison)

Professor David Boyd, Birmingham City University,

Dr Rod Gameson, University of Salford, UK

Dr Chris Harty, University of Reading, UK

Mr Noel Painting, University of Brighton, UK

Dr Wei Pan, University of Plymouth, UK

Professor David Proverbs, University of West of England, UK

Dr Milan Radosavljevic, University of Reading, UK

Dr Ani Raidén, Nottingham Trent University, UK

Dr Andrew Ross, Liverpool John Moores University, UK

Dr Chika Udejaja, Northumbria University, UK

SCIENTIFIC COMMITTEE 2012

Dr Simon Smith	University of Edinburgh, UK (Conference Organiser & Editor)
Mr Dominic Ahiaga-Dagbui	University of Edinburgh, UK (Conference Secretary)
Dr David Blackwood	University of Abertay, UK
Associate Prof. Nick Blismas	RMIT University, Australia
Mr John Bradley	Leeds Metropolitan University, UK
Dr Kate Carter	University of Edinburgh, UK
Dr Valerie Caven	Nottingham Trent University, UK
Professor Anita Ceric	University of Zagreb, Croatia
Professor Paul Chinowsky	University of Colorado Boulder, USA
Dr Alex Copping	University of Bath, UK
Dr Martin Crapper	University of Edinburgh, UK
Dr Richard Dawe	Plymouth University, UK
Dr Peter Demian	Loughborough University, UK
Professor André Dorée	University of Twente, Netherlands
Professor Richard Fellows	Loughborough University, UK
Dr Scott Fernie	Loughborough University, UK
Dr Doug Forbes	Whole Life Consultants Ltd, UK
Professor Chris Fortune	University of Salford, UK
Professor Alistair Gibb	Loughborough University, UK
Prof Steve Goodhew	Plymouth University, UK
Professor David Greenwood	Northumbria University, UK
Dr Bingunath Ingirige	University of Salford, UK
Mr Eric Johansen	Northumbria University, UK
Dr David Johnston	Leeds Metropolitan University, UK
Prof Dean Kashiwagi	Arizona State University, USA
Dr Malik Khalfan	RMIT University, Australia
Professor Christian Koch	Chalmers University of Technology, Sweden
Professor Bimal Kumar	Glasgow Caledonian University, UK
Professor Martin Loosemore	University of New South Wales, Australia
Dr Monjur Mourshed	Loughborough University, UK
Dr Sunny Nwaubani	Anglia Ruskin University, UK
Dr Edward Ochieng	Liverpool John Moores University, UK
Professor Michael Okoroh	University of Derby, UK
Dr Adebayo Oladapo	University of Central Lancashire, UK
Dr Lukumon Oyedele	Queen's University Belfast, UK
Dr Motiar Rahman	University of Dundee, UK
Professor Christine Räisänen	Chalmers University of Technology, Sweden
Professor Winston Shakantu	Nelson Mandela Metropolitan University, South Africa
Professor Brian Sloan	Edinburgh Napier University, UK
Professor John Smallwood	Nelson Mandela Metropolitan University, South Africa
Professor James Sommerville	Glasgow Caledonian University, UK
Professor Ian Strange	Leeds Metropolitan University, UK
Dr Subashini Suresh	University of Wolverhampton, UK
Dr Craig Thomson	Glasgow Caledonian University, UK
Dr David Thorpe	University of Southern Queensland, Australia
Mr Derek Thurnell	Unitec Institute of Technology, New Zealand
Dr Apollo Tutesigensi	University of Leeds, UK
Professor Sam Wamuziri	Glyndŵr University, UK

SUSTAINABILITY – (OPERATION AND PRACTICE) 1233

Evaluating factors in sustainable road construction and management – a life cycle approach - David Thorpe	1235
Investigating a suitable learning environment to advance sustainable practices among micro construction enterprises - Michael Gleeson and Craig Thomson	1245
Green building challenges: evaluating the operation of adopted building assessment tools - case study - Mpakati-Gama E.C, Wamuziri S.C and Sloan, B	1257
Investment appraisal tools and sustainability evaluation in social housing - Anthony Higham and Chris Fortune	1269
Early stage evaluation of the socio-economic benefits of built environment housing regeneration projects - Julius Akotia and Chris Fortune	1279
Building refurbishment: Holistic evaluation of barriers and opportunities - Ibrahim Babangida, Femi Olubodun and Joseph Kangwa	1289
Factors of sustainability in building design: Establishing their relative significance - Denise Quigley, George Heaney and Henry Odeyinka	1299
Integrating responsible sourcing in the construction supply chain - James Upstill-Goddard, Jacqueline Glass, Andrew R. J. Dainty and Ian Nicholson	1311
Lowering CO2 emissions in the new build social housing sector: A Spanish case study - Mark Downey	1321
Environmental assessment tools and efficiency in housing and office refurbishment - Ahmet Anil Sezer	1331
Variations in the mainstreaming of sustainability: a case study approach - Philippa Boyd and Libby Schweber	1343
Optimising the role of Facilities Management (FM) in the Development Process (DP): The development of FM-DP integration framework for sustainable property development - Matthew Tucker, Mohd Masuri and Mohd Noor	1355
Detailed design ethnography: architects embedding low carbon performance - Gabriela Zapata Poveda	1367
A critical review of the concept of facilities management in community-based contexts - Mohammad Tammo and Margaret Nelson	1379
The domestication and use of low and zero carbon technologies in new homes - Tim Lees and Martin Sexton	1389

SUSTAINABILITY – (THEORY AND DESIGN) 1399

Optimizing embodied energy of building construction through bioclimatic principles - Sattar Sattary and David Thorpe	1401
Thermal performance of buildings and the management process - Christopher Gorse, Anne Stafford, Dominic Miles Shenton, David Johnston, Ruth Sutton and Dave Farmer	1413
Key criteria of sustainable hospital refurbishment: A stakeholder review - Grant Wilson and Mohammed Kishk	1423
A multidisciplinary literature review of low and zero carbon technologies into new housing - Whitney Bevan and Shu-Ling Lu	1435
Delivering zero carbon homes in the UK - Emma Heffernan, Wei Pan and Xi Liang	1445
Delivering sustainable buildings in retail construction - Zainab Dangana, Wei Pan and Steve Goodhew	1455
A conceptual model for user-centred passive building design - Alzaed A and A.H.Boussabaine	1467
Diagrammatic representations of sustainability – A review and synthesis - Stuart Moir and Kate Carter	1479

INDEX OF AUTHORS 1491

INDEX OF KEYWORDS 1495

INDEX OF AUTHORS

A

Aboagye-Nimo, E, 413
Acquah, S, 563
Agnew, B, 89
Agyekum-Mensah, G, 1055
Ahiaga-Dagbui, D D, 307
Ahmad, A M, 33
Aigbavboa, C, 295
Akortia, J, 1279
Alasad, R, 327
Alasamri, H, 475
Aloini, A, 675
Alsulamy, S, 1101
Alsuliman, J, 1003
Alzaed, A, 1467
Amakali, T R, 285
Anigbogu, N A, 969
Ankrah, N, 465, 665, 979
Anvuur, A, 807
Arewa, A O, 423
Austin, S, 57, 177
Awinda, K, 1209

B

Babangida, I, 1289
Bajracharya, B, 123
Baldursdóttir, N, 863
Bassioni, H, 381
Berg, S, 645
Bevan, W, 1435
Biggs, H C, 445
Boothman, C, 991
Borthwick, F, 487
Bosch, P, 645
Bosher, L, 1187
Boussabaine, A H, 1467
Bowen, P, 521
Bower, D, 1121
Bowles, G, 475, 1003
Boyd, P, 1343
Brewer, G, 1175
Bridge, A, 913
Bryde, D J, 1013
Buser, M, 261
Bust, P, 455

C

Callaghan, N, 1025
Calzadilla, E, 1209
Cammarano, C, 797
Carrillo, P, 213
Carter, K, 1479
Cattell, K, 521
Caven, V, 273, 577
Chan, P W, 497
Chand, A M, 101

Chen, Z, 1003
Chileshe, N, 3, 589
Chinyio, E, 665
Chow, V W, 1157
Chrisp, M.T., 475
Cook, G, 285
Craig, N, 1025
Crapper, M, 553
Crawford, L, 123
Crowe, P, 901

D

Dainty, A, 213, 455, 1187
Dainty, A R J, 67, 1311
Dangana, Z, 1455
Davies, R, 23
de Weerd, M, 655
de Wilde, P, 357
Demian, P, 33
Demir, S T, 1013
Deng, F, 807
Doughty, N, 707
Downey, M, 1321
Dulmin, R, 675

E

Eadie, R, 337, 717
Eckert, C, 1089
Edum-Fotwe, F, 707
Edwards, P, 521
Elhag, T, 1079
El-Haram, M, 317
Elmasry, M I, 381
Emsley, M, 1219
Emuze, F A, 189, 1167
Erdongan, B, 817
Eriksson, T, 697

F

Farmer, D, 1413
Farrell, P, 393, 403, 423
Fearon, D J, 1013
Feng, Y, 763
Fernie, S, 533
Forbes, D, 317
Fortune, C, 145, 841, 901, 1269, 1279
Fuentes-del-Burgo, J, 601
Furber, A, 553

G

Gajendran, T, 1175
Gan, S W, 347
Garmston, H, 357
Garthwaite, P, 1089
Gibb, A, 57, 775

Gibb, A, 455
Glass, J, 1187, 1311
Gleeson, M P, 1245
Gluch, P, 645
Gof, R, 1175
Goodhew, S, 1455
Gorse, C, 1413
Gosling, J, 633
Greenwood, D, 89
Gunning, J G, 167

H

Hagan, G, 1121
Hammond, F, 465, 979
Hao, J, 177
Harre-Young, S, 1187
Harty, C, 13, 23, 45
Heaney, G, 1299
Heffernan, E, 1445
Herder, P, 655
Higham, A, 991, 1269
Ho, P H K, 369
Hojo, T, 223
Holliday, S, 787
Horner, M, 317
Horsfall, B, 991
Horsthuis, C, 533
Hughes, W, 77, 727

I

Iranagh, M A, 1047
Issa, D, 1219
Iyer-Raniga, U, 201

J

Johnston, D, 1413

K

Kabiri, S, 727
Kadefors, A, 697
Kangwa, J, 1289
Katsanis, 177
Kestle, L, 111
King, A, 413
Kirkham, R, 1219
Kishk, M, 1423
Knight, A, 1055
Koch, Christian, 261
Koskela, L, 687
Kušljčić, D, 1111
Kwok, T, 913

L

Lahdenperä, P, 945
Langston, C, 123
Larkin, K, 337

Larsen, G D, 285
Larsson, J, 751
Leblanc, H, 1145
Lees, T, 1389
Legnerot, C, 645
Liang, X, 1445
Liguori, D, 925, 935
Lilley, S, 317
Lim, P G, 347
Lindström, A, 645
Llyod-Walker, B, 877
Loosemore, M, 101, 543, 787, 1135, 1157
Lu, S, 1435
Ludvig, K, 851

M

Maftai, L, 13
Manase, D, 925, 935
Mante, J, 979
Manu, E, 665
Manzoni, B, 829
Marenjak, S, 1111
Masuri, M R A, 1355
McAndrew, P, 487
McArdle, K, 167
McCarney, M, 739, 775
McClements, S, 717
McDonnell, G, 1157
Mihara, H, 223
Mininno, V, 675
Moir, S, 1479
Mojtahedi, M S H, 133
Morris, P, 829
Morrison, E, 249
Morton, D, 89
Motawa, I, 327
Mzyece, D, 465

N

Navarro-Astor, E, 577, 601
Ndekugri, I, 465, 979
Ndoni, D H, 1079
Neitzert, T R, 621
Nelson, M, 1379
Newton, K, 3
Nicholson, I, 1311
Nilsson, M, 645
Noble, R, 393
Noor, M N M, 1355
Noor, N M, 611
Nyaketa, N, 455

O

O'Keeffe, D J, 67
Ochieng, E G, 1013
Odeyinka, H, 337, 717, 1299
Ogungbemi, Y O, 611
Ogunlana, S, 327, 817

Oladapo, A, 433
Olubodun, F, 1289
Oo, B L, 133
Ottosson, E, 863
Ozols, R, 841

P

Pala, M, 707
Pan, W, 357, 1445, 1455
Parkin, A, 1209
Pasquire, C, 1055
Patel, M, 403
Peters, C, 707
Poh, P, 177
Ponticelli, S, 675
Potangaroa, R, 111
Poveda, G, 1367
Powell, A, 237
Price, A D F, 33
Proverbs, D, 665

Q

Quigley, D, 1299

R

Radosavljevic, M, 509
Ragheb, M, 381
Rahman, A, 913
Raiden, A, 273, 413
Räisänen, C, 273
Reed, H, 543
Robinson, A, 57
Rooke, J, 687
Rowlinson, S, 913
Ruikar, K, 707

S

Sang, K, 237
Sattary, A, 1401
Sazalli, S H, 89
Scharpff, J, 655
Schultz, C S, 1067
Schweber, L, 727, 1343
Scott, L, 145, 155
Sergeeva, N, 509
Setiawan, H, 817
Sexton, M, 1389
Sezer, A A, 1331
Shah, M I A, 77
Shakantu, W M, 1167
Shaurette, M, 155
Shenton, D M, 1413
Sherratt, F, 393, 403
Shipton, C, 957
Shwarka, S M, 969
Sidoli del Ceno, J, 889
Simonsson, P, 751

Sloan, B, 1257
Smallwood, J J, 189
Smith, N, 1121
Smith, S D, 307, 553
Smyth, H, 829
Smyth, H J, 807
Soetanto, R, 177
Sommerville, J, 925, 935, 1025
Sonmez, R, 1047
Spillane, J P, 167
Stafford, A, 1413
Stenberg, A, 851
Stokes, C, 213
Subbiah, A, 1035
Sutton, R, 1413
Suzuki, K, 223

T

Taggart, M, 687
Tammo, M, 1379
Tang, L C M, 77
Tang, Y H, 347
Taylor, M, 1101
Tennant, S, 739
Teo, M M M, 1135
Thomson, C, 1145
Thomson, C S, 1245
Thomson, D, 533
Thomson, D S, 67
Thorpe, D, 1235, 1401
Thurnell, D, 249
Thwala, W, 295
Tietze, S, 413
Tokede, O, 1197
Tong, M K L, 739
Towill, D, 633
Tryggstad, K, 45
Tucker, M, 1355
Tucker, M P, 611
Tuuli, M M, 563

U

Upstill-Goddard, J, 1311

V

Vilasini, N, 621
Volker, L, 655

W

Walker, D H T, 877
Wamuziri, S, 1101, 1197
Wamuziri, S C, 1257
Whyte, A, 797
Williamson, A R, 445
Wilson, G, 1423
Windapo, A, 433
Wingrove, D, 201

Wu, P, 763

Youssef, A A, 381

Y

Yirenkyi-Fianko, A B, 589

Yoshida, T, 223

Z

Zhong, Y, 763